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CONVEYING AN ESSENTIALLY SHEET-SHAPED ELEMENT, IN PARTICULAR, A SHEET OF PRINTING MEDIUM

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CROSS-REFERENCE TO RELATED APPLICATIONS

Reference is made to the following commonly assigned applications, the disclosure of which is incorporated herein by reference:

U.S. Patent Application Serial No. _____, filed on March 1, 2004, by Dobrindt, entitled, "TRANSPORTING AN ESSENTIALLY SHEET-LIKE ELEMENT, PARTICULARLY IN A PRINTING PRESS";

U.S. Patent Application Serial No. _____, filed on March 1, 2004, by Dobrindt, entitled, "APPARATUS FOR TRANSPORTING A SHEET-LIKE ELEMENT";

U.S. Patent Application Serial No. _____, filed on March 1, 2004, by Dobrindt, entitled, "TRANSPORTING AN ESSENTIALLY SHEET-SHAPED ELEMENT, PARTICULARLY A PRINT MATERIAL SHEET"; and

U.S. Patent Application Serial No. _____, filed on March 1, 2004, by Goldbeck, entitled, "CONVEYING AN ESSENTIALLY SHEET-SHAPED ELEMENT, IN PARTICULAR, A SHEET OF PRINTING MEDIUM".

FIELD OF THE INVENTION

The invention relates to conveying an essentially sheet-shaped element, in particular, for conveying a sheet of printing medium in a printing machine in which the sheet-shaped element is: 1) picked up by at least one rotating conveying component having at least one jaw-shaped receiver for introducing or inserting the leading edge of the sheet-shaped element at a pickup point located in the area of its leading edge, and 2) carried along to a stacking point where it is stacked, whereby the sheet-shaped element is bowed around a rotational radius or a radius of curvature.

BACKGROUND OF THE INVENTION

A sheet-shaped element conveyor is known in prior art, for example from a patent DE 199 04 853. Therein, a so-called stacking wheel is used as a rotating conveying component for conveying and stacking banknotes, in particular. For this purpose, banknotes are introduced individually into jaw-

shaped receivers and held there. For the purpose of securely holding the banknotes, spring-loaded limiting blades are attached to the jaw-shaped receivers in order to achieve a radial force component that is oriented inward toward the wheel hub of the conveying component, by which the individual banknote is clamped in the jaw-shaped receiver. In this regard, care must be taken that in order to avoid damage to the edge of the element caused by reaching the end of travel, the sheet-shaped element must not, for the sake of holding the sheet-shaped element firmly in the jaw-shaped receiver, be inserted too deeply into the receiver such that it reaches the receiver's end of travel. The known arrangement, is from the mechanical standpoint, relatively expensive and subject to malfunctioning, and is relatively undependable due to its reliance upon spring tension while picking up, conveying, and stacking the sheet-shaped element.

In addition, another apparatus is known from U.S. Patent No. 4,431,177, with which sheets can be stacked with an offset. With the possibility of an offset shifting of the sheet-shaped elements as they are deposited on the top of the stack, it is, for example, possible to form partial stacks that are offset from one another and can thus be more easily lifted up and separated. In the known apparatus, the problem is that the shifting component used to achieve the offset is a swivel arm that is mounted such that it essentially swings back and forth, is relatively complicated from the mechanical standpoint, and requires substantial space.

SUMMARY OF THE INVENTION

The objective of this invention is to raise the level of reliability, during the conveying and stacking process, in particular, at higher conveyance speeds and preferably without regard to the characteristics of the sheet-shaped element, whereby preferably offsetting of the sheet-shaped elements could be achieved on demand.

This objective is achieved in that the sheet-shaped element is held by at least one retaining component located in the area of the jaw-shaped receiver, in particular, proactively, and by force. In this manner, the sheet-shaped element is held securely, conveyed, and released at the proper place for stacking. Preferably, provision is made for the sheet-shaped element to be subject to a

clamping pressure applied by the retaining component in the jaw-shaped receiver, in order to hold it securely with simple means and at the same time to avoid damaging it.

A preferred embodiment of the invention provides for the retaining component to be a swivel arm that can move in an approximately radial direction to the rotational movement of the conveying component and that rotates along with the conveying component. The co-rotational swivel arm that is assigned to the jaw-shaped receiver can beneficially be swiveled radially outward after a sheet-shaped element has been introduced into the receiver, in order to hold the sheet-shaped element in the receiver, in that the swivel arm thrusts against its countervailing force on a wall of the receiver, against which it presses the sheet-shaped element. After conveyance, the swivel arm can be moved so as to open the receiver and release the sheet-shaped element for stacking.

A further development of the invention provides for the retaining component to be movable by an actuating component that is essentially an eccentric, preferably as an eccentric that can be rotated around an axis that is parallel to the rotational axis of the conveying component and is supported by the conveying component. As such, the eccentric in at least one rotational position of the conveyance component essentially closes the jaw-shaped receiver by the retaining component and in at least one other relative rotational position leaves the jaw-shaped receiver essentially open. Preferably, the eccentric is a cam disk and is attached to the conveying component.

Thus, the swivel arm is forced to move in a closing direction by an eccentric on a cam disk whenever it passes the eccentric during rotation of the conveying component. For this, the eccentric must be aligned, oriented, and extended in the direction of rotation such that the swivel arm causes the closing at the correct point in time during the rotation and for the proper amount of time. At the end of the eccentric area in the direction of rotation, the swivel arm once again is given sufficient clearance for movement. It is not necessary that the swivel arm be forced in an opposite direction. In principal, it can remain in the closed position without actually imposing pressure. The absence of pressure is, however, sufficient for releasing the sheet-shaped element, which is now no longer clamped

in place, if it is, for example, pushed out of the receiver. It is, of course, also conceivable, although more expensive, for the swivel arm to be mechanically forced back into the open position, in the simplest case, by suitable spring loading.

The actuating component and the conveying component are preferably driven in a predetermined speed ratio, one to the other. Preferably, the speed relationship of the conveying component to that of the actuating component should be predetermined at 1:2. This will allow for the sheet-shaped element to be held and released as a function of the rotation of the conveying component, preferably such that during one revolution the jaw-shaped receiver is opened twice and closed twice, so that a sheet-shaped element, for example, can be picked up at an upper pickup point when the receiver is open, be held by the closed receiver for one half a revolution, and be released at a lower release point when the receiver is open.

In another embodiment of the invention, at least one shifting component is connected to the conveying component and is used to offset the sheet-shaped element in the area of the release point such that the sheet-shaped element will lie essentially parallel to the rotational axis of the conveying component. In this way, at the end of the conveying step, and preferably coordinated therewith, a decision can be made as to whether sheet-shaped elements will be released and stacked with an offset, in order to form partials stacks that can more easily be separated from one another. In this regard, the shifting component is preferably connected to the conveying component so as to produce a forced movement as a function of the rotational position of the conveying component. For example, provision can be made for a curved track that is stationary relative to the conveying component and is used to forcibly move the shifting component laterally. In particular, the shifting component can be located on the holding component itself; preferably the shifting component will be located in the area of the free end of the swivel arm.

For secure clamping of the sheet-shaped element and for easier release when the hold is released, it is preferable that the area of the shifting component that makes contact with the sheet-shaped element have a relatively higher frictional resistance than that of the contact area on the jaw-shaped receiver

against which the shifting component presses. A lateral shift will also be aided thereby.

Another development of the invention provides for the conveying component to be a disk.

It is preferred that a number of jaw-shaped receivers are evenly distributed over a full 360° and that a retaining component is assigned to each receiver in order to convey two or more sheet-shaped elements simultaneously, or at least to be able to pick up the next sheet-shaped element to be conveyed, precisely as the sheet-shaped element that was just conveyed is stacked, for which purpose then two jaw-shaped receivers that are located diametrically opposite to one another are provided.

In addition, provision can be made beneficially for at least, jaw-shaped receiver to be essentially a slot or slit. In doing so, care can beneficially be taken for the length of the slot to incorporate sufficient clearance for the leading edge of the sheet-shaped element without the danger that the leading edge will butt against the face of the slot. In addition, provision can be made for a stacking disk of the same diameter to be located parallel to the conveying component and to be able to rotate along with it. This stacking disk will have neither a receiver nor a retaining component, but will serve as a supplemental support and bending component for the sheet-shaped element.

At the point of release, delivery and stacking of the sheet-shaped element can be simply achieved in that in the area of the point of release a stationary arresting bar for the leading edge of the sheet-shaped element that is inserted in the receiver is located across from the conveying component, and against which the sheet-shaped element bumps such that the sheet-shaped element comes loose from the jaw-shaped receiver when the conveying component itself, unimpeded by the arresting bar, continues to move. For this purpose, an arresting strap can be provided that has a sufficiently large opening through which the conveying component can pass.

For a better alignment of the sheet-shaped element, even while being conveyed, provision is preferably made for two or more conveying components and/or stacking components that are coaxially separated from one

another. Preferably, two conveying components are aligned as mirror images in relation to a reflective plane that is perpendicular to the rotational axis.

BRIEF DESCRIPTION OF THE DRAWINGS

Shown in the drawing are embodiments from which additional inventive characteristics can also be derived, but to which the invention is not limited. Shown schematically are:

FIG. 1 which is a partially sectional side view of an embodiment of a conveying component according to the invention;

FIG. 2 which is a side view of a second embodiment of a conveying component according to the invention;

FIG. 3 which is a front view of the conveying component shown in FIG. 2; and

FIG. 4 which is a representation of an enlarged section from the side sectional view shown in FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a conveying component according to the invention. This conveying component incorporates, in particular, a stacking disk 1, the full surface of one side of which can be seen, however, in a partial section. The stacking disk 1 rests on a shaft. For the purpose of rotating the stacking disk 1, this shaft 2 can be driven by a drive (not shown). Located on the shaft 2 behind the stacking disk 1, and shown by dashed lines in the depiction shown in FIG. 1, is a gear wheel 3 that can be driven along with the stacking disk 1. Gear wheel 3 meshes with four other gear wheels 4 that are located on the stacking disk 1 and that can be rotated by axles 5, each of which has an eccentric or cam, or a cam disk 6. The eccentric area of the cam disk 6, which brings about a radially greater distance from the axle 2 than does the remaining area of the cam disk 6, extends around the circumference of the cam disk, i.e., around a certain sector thereof, for example, approximately 240° in relation to the assigned axle 5.

The stacking disk 1, has two slots 7 that, in relation to the shaft 2, are located diametrically and point symmetrically opposite to one another and serve as jaw-shaped receivers for holding sheet-shaped elements 8. The leading edge of a sheet-shaped element 8 is pushed into a slot 7 that is located in the upper

position at the depicted point of rotation of the stacking disk. To insert the sheet-shaped element 8 into the slot 7, conveying rollers 9 at the end of a paper path, for example, are used. The sheet-shaped element 8 that has been picked up is then brought to a lower level through a half-rotation of the stacking disk 1, where it is then stacked on a stack (not shown), in that it is pushed out of the slot 7 that is now in the lower position. Such a sheet-shaped element 8 that is in the process of being stacked is also shown in FIG. 1. The sheet-shaped element 8 is pushed out of the slot 7 through an arresting bar 10 that has an opening through which the stacking disk 1 can rotate without being impeded, whereby, however, the sheet-shaped element 8 butts against the arresting bar 10 and is held back such that it comes out of the slot 7, as the slot 7 continues to move.

Connected to the stacking disk 1, by an axle 12, is a swivel arm 11 for each slot 7 that can be swung about at one end about axle 12. At the opposite end of each swivel arm11, the arm projects into the slot 7. The middle area of the swivel arm 11 runs on the cam disk 6, by a wheel 13, while it rotates together with the stacking disk 1 around the shaft 2. When it is in the eccentric area of the cam disk 6 it is always forcibly moved radially outward, so to speak "lifted up" relative to the shaft 2 or the axle 5, whereby the outward facing end penetrates laterally more deeply into the slot 7 and presses a sheet-shaped element 8 that has been picked up, against the wall of the slot with retentive pressure. Thus, the swivel arm 11 immobilizes the sheet-shaped element 8 while it moves counterclockwise downwards with the stacking disk 1, in FIG. 1, the trailing edge of the element being released by the conveyer rollers 9 of the paper path and requiring additional support. The swivel arm 11 releases the sheet-shaped element 8 when its leading edge (turned in the meantime) abuts against the arresting bar 10, so that the sheet-shaped element 8 can come out of the slot 7 to be stacked. In order to support the releasing movement, the swivel arm 11 is spring-loaded by a spring 14. The additional support, provided by the swivel arm 11 to the sheet-shaped element 8 in the slot 7, is particularly effective in the case of sheets that are larger in size. For example, sheets above DIN A 3 have a higher specific gravity, such as 300 grams per square meter, and are consequently stiffer because these types of sheets are longer and more difficult to bow. Therefore, they necessitate a stacking disk 1 of

greater diameter, for example, one of at least 90 millimeters. This additional support, however, is also particularly useful for smaller sizes when they are conveyed on a larger stacking disk 1, because the smaller sized sheets are even more certain to be released by the previously-mentioned conveying rollers 9 long before they have reached the lower stacking position.

The slots 7 are formed on the stacking disk 1 by the sheet metal tongues 15 that constitute the outer walls of the slots 7, being inserted at one end into the slit 16 and attached with screws 17 that are screwed tightly into the tapped holes 18.

FIG. 2 shows a side view of a second embodiment of a conveying component. The same components are identified with the same reference numbers as in FIG. 1. The embodiment shown in FIG. 2 corresponds extensively to the embodiment shown in FIG. 1. Nevertheless, in FIG. 2, a shifting component 19 for laterally shifting a sheet-shaped element 8 during stacking is additionally located on the swivel arms 11. The shifting component 19 in each case can be laterally moved along a slideway 20; i.e., as shown in FIG. 2, it can be slid into the plane of the drawing or out of the plane of the drawing.

The method of operation of one of the shifting components 19 will become clearer by viewing FIG. 3, which shows a frontal view of the conveying component, according to the invention that is shown in FIG. 2. The shifting component 19, as described with reference to FIG. 2, is connected via a slideway 20 to the swivel arm 11 that rolls away or is guided in a rotating motion, via a wheel 13 on the cam disk 6 around its axis 12, in order to open or release the slot 7. The shifting component 19 follows the movement of the swivel arm 11, including its rotation along with the stacking disk 1 around the shaft 2. In the course of this rotation around the shaft 2, the shifting component 19 itself, is guided further, laterally on a curved track 21, by a slide ring arm or a ball bearing 23. This curved track 21 is stationary in relation to the rotation of the stacking disk 1, and is thicker, or has a shoulder 22 in its lower area, i.e., in the area of the arresting plate 10. The effect of the shoulder 22 is that in this area the shifting component 19 is forcefully shifted to the right, as shown in FIG. 3. In doing so, it carries the sheet-shaped element along by friction and deposits it with an

appropriate offset on a stack. When the shifting component 19 leaves the area of the shoulder 22, it is returned to its original position by a return spring 24.

FIG. 3, without regard to what has been described above, shows that provisions can be made for an additional bending disk 25 located parallel to the stacking disk 1, resting on the same axle and rotating co-axially with the stacking disk 1. The additional bending disk 25 is available as a supplemental support for the sheet-shaped element 8 as it is being conveyed and bent.

FIG. 4 shows, in a sectional enlargement, details of a swivel arm 11 with a shifting component 19, in an enlarged side view of a portion of FIG. 2. FIG. 4 merely further clarifies the elements described in FIG. 2.

The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.